With the compliments of
K.S. Venkataramani.
(Botanist).

UNITED PLANTERS' ASSOCIATION OF
SOUTHERN INDIA

TEA SCIENTIFIC SECTION

ANNUAL ADMINISTRATION REPORT

FOR

1948-49

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UNITED PLANTERS' ASSOCIATION OF SOUTHERN INDIA

ANNUAL REPORT OF THE U.P.A.S.I. TEA SCIENTIFIC SECTION 1948-49

Staff.—Mr. J. D. Manning, Tea Scientific Officer, resigned his appointment as from October 1948 and pending the appointment of a successor to him, Mr. S. Ananda Rau acted as the Tea Scientific Officer for the rest of the year.

Mr. K. S. Venkataramani, M.Sc. was appointed in May 1948, temporarily for one year, to investigate the problem of ' defoliation ' in tea. After a period of 5 months he was offered in October 1948 the permanent post of Botanist which was vacant from the beginning of the year.

A new post of Recorder at Devarshola was sanctioned by the Committee and Mr. E. Powell was appointed to this post. He joined duty in May 1948.

Mr. K. V. Govindan Nair, Clerk, resigned his post in April 1948 and Mr. V. Raman, B.Sc. was appointed in his place in July 1948.

Mr. S. Ananda Rau, Asst. Tea Scientific Officer and Entomologist, was stationed on Arnakal Estate in Central Travancore from April 1948 to January 1949 for work in connection with the control of *Helopeltis* with DDT dusting. He returned to the Devarshola Station in February 1949.

Mr. V. Jayaraman, Soil Chemist, was in charge of the Devarshola Station from April 1948 to January 1949.

Administration.—The Tea Scientific Officer had his headquarters at ' Glenview ', Coonoor until his departure at the end of September. The Acting Tea Scientific Officer continued to remain in Central Travancore until the beginning of February 1949 when he moved to the Devarshola Station.

Mr. W. I. Hatherall, member, Tea Section Committee, paid an official visit to the Station on 31st October 1948.

Correspondence.—Full records of correspondence dealt with at the Tea Scientific Officer's headquarters at Coonoor for the period April to September 1948 are unfortunately not available. Even a rough estimate is rendered difficult by the fact that for over two months the Tea Scientific Officer was without a Clerk. At the Devarshola Station 922 letters were received and 1,112 despatched. In Central Travancore the numbers of letters received and despatched by the Asst. Tea Scientific Officer (later Ag. Tea Scientific Officer) were 508 and 410 respectively.

Buildings.—Only minor repairs were done to buildings and the usual upkeep was maintained. With the return of the Acting Tea Scientific Officer from Travancore, a re-sorting of staff accomodation became necessary. The Soil Chemist who was in occupation of the Assistant (now Acting) Tea Scientific Officer's bungalow moved to one part of the Tea Scientific Officer's bungalow, the other part being occupied by the Botanist. As no separate accomodation was available on the Station for the Clerk, he has been housed in the nursery wing attached to the Tea Scientific Officer's bungalow.

Water Supply.—The water supply position was unsatisfactory for a part of the year. One of the two pumps was long out of order and the other pump too broke down so that until it was repaired the Station was without running water for over a month. Unless the water is pumped alternately from the two existing wells, the water requirements of the Station during the dry weather cannot be adequately met and it is hoped that the present unsatisfactory position will be remedied during the coming year.

Publications.—The following notes, reviews, articles and papers were published during the year.

(1) The Effect of Hard Plucking (with special reference to Blister Blight) by T. Eden—Note by Tea Scientific Officer, U.P.A.S.I.,—(*Planters' Chronicle*, Vol. XLIII, No. 7, April 1, 1948).

(2) Weed Killers by V. A. Beckly—Note by T.S.O., U.P.A.S.I., (*Planters' Chronicle*, Vol. XLIII, April 1, 1948).

(3) Helopeltis trials (1947)—Preliminary Report—by S. Ananda Rau (*Planters' Chronicle*, Vol. XLIII, No. 8, April 15, 1948).

(4) An Interim Report on Experiments for the Control of Helopeltis in Tea by J. D. Manning, (*Planters' Chronicle* Vol. XLIII, No. 18, September 15, 1948).

(5) A Note on Coffee Research in South India by W. W. Mayne—Review by J. D. Manning, (*Planters' Chronicle*, Vol. XLIII, No. 19, October 1, 1948).

(6) A Hand Book on Blister Blight for Tea Estates in South India by J. D. Manning—Paper No. 5, U.P.A.S.I., Tea Scientific Section.

(7) Vegetative Propagation of Tea by Internodal Cuttings—A short guide to the Technique for Tea Estates in South India by J. D. Manning—Paper No. 6, U.P.A.S.I., Tea Scientific Section.

Touring.—The Tea Scientific Officer visited Central Travancore in April, May and August and High Range in June 1948. He also visited a few Estates in the Nilgiris in April and the Devarshola Station in May. In addition, he made a visit in May to the Tea Research Institute, Ceylon.

The Asst. Tea Scientific Officer visited a number of Estates in Central Travancore while in residence in that district. He also visited an Estate in South Travancore in September 1948 and two Estates in Nilgiris in February 1949.

The Soil Chemist visited two Estates in Nilgiris and Nilgiri-Wynaad in connection with field experiments and 'defoliation' and also made periodic visits to neighbouring Estates to carry out spraying and dusting trials against Blister Blight.

The Botanist paid a visit in September 1948 to a group of Rubber Estates to investigate a leaf disease of Rubber. In February 1949 he visited a group of Tea Estates in Nilgiri-Wynaad in connection with ' defoliation ' and a Cardamom Estate in March 1949 to study the cause of deterioration of Cardamom. In addition, he also made a few visits to Estates in the neighbourhood of the Tea Experimental Station.

Scientific Conference.—A Scientific Conference was held at the time of the Annual U.P.A.S.I. Conference in August 1948 and was presided over by Mr. F. G. Wallace, President of the U.P.A.S.I. The programme included addresses on the following subjects :—

(1) Recent Developments in Tea Protection—by Mr. J. D. Manning, Tea Scientific Officer, U.P.A.S.I.

(2) The Exploitation of Plant Variability for the Improvement of Plantation Agriculture—by Mr. W. W. Mayne, Scientific Officer, K.D.H.P. Co., Ltd.

(3) Plant Variability in relation to Plant Pathology Problems.—by Mr. E. H. Hainsworth, Pathologist, I.T.A. Experiment Station, Tocklai.

(4) The Exploitation of Plant Variability for the Improvement of Yield in Coffee—by Mr. K. M. Thomas, Director of Research, Indian Coffee Board.

Each address was followed by a discussion in which several members participated. With reference to subject No. 1 notes had been prepared previously by Mr. J. D. Manning on ' Spraying Pruned Tea ' and ' Control of *Helopeltis* ' and copies of these were distributed at the meeting.

U.P.A.S.I. Exhibition.—A noteworthy feature of the year was the holding of an Exhibition at the time of the U.P.A.S.I. Annual Conference in August 1948. Various types of plant protection equipment and materials and other Estate requisites were displayed at the Exhibition by firms interested in these products. Demonstrations of special equipments were also arranged.

Demonstration of Helopeltis Control in Travancore.—During the course of work in Central Travancore a demonstration of *Helopeltis* control was held on Arnakal in May 1948 at which several members of the Central Travancore Planters' Association were present. The process of preparing DDT for dusting and the technique of operations with hand and power dusting machines were demonstrated.

Visitors.—Mr. E. H. Hainsworth, Tea Pathologist at the Indian Tea Association Experimental Station, Tocklai, visited South India in August 1948. He attended the Annual Conference at Coonoor and later visited Devarshola Station and also Central Travancore where *Helopeltis* control operations were in progress.

Mr. Stapley, Entomologist attached to Messrs. Plant Protection Ltd., accompanied by Mr. Coleman of the Imperial Chemical Industries visited Central Travancore in connection with dusting operations undertaken there.

Messrs. B. Lessware and K. V. Ramakrishnan, both of the Imperial Chemical Industries, visited the Devarshola Station to discuss plant protection problems.

The Bio-Chemist and Geneticist of the Coffee Research Station, Balehonnur, also paid a visit to the Station in February 1949.

Contacts and discussions with all these visitors were of the greatest value to the staff.

Indian Council of Agricultural Research.—The Tea Scientific Officer served as U.P.A.S.I. representative on this Council and attended the meetings held in Madras on 7th—10th April 1948.

Meetings.—During the course of his tour, the Tea Scientific Officer attended and addressed meetings of District Planters' Associations. Mr. E. H. Hainsworth, Tea Pathologist of Tocklai Experiment Station, who had come down to South India, addressed a meeting of members of the Central Travancore Planters' Association in August 1948.

Monthly Proceedings Reports.—These reports, summarising the work carried out by the Department each month, continued to be issued to the Tea Section Committee.

Field Experiments.—All the field experiments started and reported on in previous years were continued. In addition, several short-term experiments on spraying and dusting against Blister Blight, different systems of plucking in relation to Blister Blight attack and a series of trials with DDT in the control of *Helopeltis* were carried out and completed during the year. These are referred to in detail in later sections of the report.

Manuring.—The results of manurial experiments in progress are given in the Soil Chemist's report. The general trend of these results has been that a response to nitrogen is usually obtained. There are, however, exceptions and in these cases, the lack of response is attributed to shade and/or other limiting factors. The precise nature of the limiting factors is but little understood at present and, with the continuance of the experiments, the accumulated data should throw more light on this question.

An interesting feature of present year's results was a significant response to potash noted for the first time in the Station manurial experiment. This has occurred in the 8th year of the experiment, there being no response during the previous 7 years. This finding is of interest in that it agrees with the results obtained by the T.R.I. Ceylon who report that in their experiments the effect of withholding potash began to be felt in the 12th year of the experiment.

Pests and Diseases.—The importance of further work on pest and disease problems has been indicated in last year's report. The work of the staff during the year under report was almost wholly devoted to problems connected with Blister Blight, *Helopeltis* and ' defoliation '. The Asst. Tea Scientific Officer spent 10 months of the year in Central Travancore carrying out trials with DDT in *Helopeltis* control. The Soil Chemist and the Botanist were engaged in trials with spraying and dusting against Blister Blight and in the study of the problem of ' defoliation '. The results of work done during the year are given in detail in their reports.

1. *Helopeltis.*—Control trials carried out in Central Travancore demonstrated the value of DDT dusting and brought the control of this pest within range of practical possibility. Initial difficulties in mixing and technique have been overcome to a large extent, but there still remain a few aspects on which further work is necessary. These are outlined in the Entomologist's report and work on them is planned for the coming year.

It is gratifying to be able to record here that, as a result of the trials conducted in Central Travancore, several estates in that district carried out dusting, some of them on a fairly extensive scale. It is anticipated that a very much larger acreage will come under dusting during the 1949 season.

2. *Blister Blight.*—Work on Blister Blight included spraying and dusting trials, both in nursery and in pruned tea, trial with a combination spray to deal simultaneously with both Blister Blight and *Helopeltis* and a plucking experiment. Spraying trials have indicated that Pere .ox at 2 ozs. in 10 gallons is as effective as at 4 ozs. Dusting with Perelan 1 , a copper fungicide dust supplied by Messrs. Imperial Chemical Industries, was found to be less efficient than spraying with Perenox at the rates of application tried, viz., 8 lbs. and 16 lbs. per acre. The latter rate was more effective than the former but still fell short of the efficiency reached by the Perenox spray.

As a result of enquiries made of several firms in U.K. and U.S.A. interested in developing fungicide formulations, a few organic fungicides have been suggested for trial and it is hoped to test these formulations during the coming year.

The object of the combination spray including both an insecticide and fungicide was to see if it can be employed in the control of *Helopeltis* and Blister Blight at the same time in districts in which attacks from both are experienced. Perenox and DDT were used for the trial. While these two appeared to be compatiable and a combination would result in a small saving of application costs, other difficulties such as the timing of applications and the larger number of rounds required to control Blister Blight would seem to put the combination spray out of court.

The plucking experiment involving 3 different systems of plucking has given results which show that continued hard plucking compared unfavourably with the other systems and produced significantly less crop. There was indication, however, that the incidence of disease was somewhat less with hard plucking, but much reliance cannot be placed on this feature as the system of recording the disease incidence on the basis of shoot counts leaves much to be desired. Nevertheless, there is reason to believe that hard plucking at carefully selected periods during the season might prove useful in reducing the severity of the disease and minimise crop losses without adversely affecting the health of the bush.

There appears to be some misapprehension in some quarters as to the precise nature of the recommendations made in the matter of shade policy. It is necessary to emphasise that suggestions for control of shade were made with extreme caution and that at no time was indiscriminate removal or thinning out of shade ever advocated. It was recommended to keep the shade at the lightest in 'the broken weather of April/May and in the North-East monsoon period ' and to maintain a high canopy of filtered shade rather than a low dense ' umbrella ' shade. It is rather unfortunate that shade removal should have been overdone as was the case on a few places.

Towards the latter part of the last Blister Blight season Brown Blight made its appearance in association with Blister Blight causing premature blackening of blisters. This was hailed in the press as a cure for Blister Blight provided by nature. On going into the question, it was found that the premature blackening of blisters was the result of activities of other fungi. Two of these fungi were *Colletotrichum camelliae* and *Pestalozzia theae*, Brown and Grey Blight fungi, the former being the more prevalent. These were noticed in association with blisters in Central Travancore, Nilgiris and Nilgiri-Wynaad and probably occurred in other districts too. They were also reported from Ceylon at about the same time. Further observations on this Blister-Brown Blight association revealed that the latter fungus can at best reduce spore production of the former and to

that extent it might be beneficial. The chances of its being used as a control for Blister Blight are considered very remote. It would, nevertheless, be of interest to watch it during the coming season to see how far its activities provide a check on Blister Blight.

3. *Defoliation.*—The problem of ' defoliation ' received further attention during the year and the major portion of the time of the Botanist was devoted to study of three possible causes, viz., virus, effect of drought and deficiency of any nutrient. On the question of virus, neither anatomical studies nor budding and grafting so far done have given any clue of a positive nature to say that a virus is involved in the trouble.

The cumulative effect of drought as a possible reason affecting the physiology of the bush and interfering with the normal uptake of nutrients is becoming increasingly suggestive, but the intricacy of the problem has prevented much headway being made in this aspect of study. Soil moisture fluctuations are proposed to be studied during the coming year and a trial is also planned, if suitable area becomes available, to test the effect of artificial irrigation during the dry weather.

Work on nutrient deficiency was prompted by the appearance of ' defoliation ' symptoms in many of the plots of the manurial experiment in progress on the Station. A census taken of bushes in all the 27 plots comprising this experiment indicated that plots which had received no potash for the past 7 years had markedly more ' defoliation ' than those which had received 20 lbs. and 40 lbs. potash. This indication was followed up by chemical analysis of leaves which revealed a definite deficiency of potash in the leaves of defoliating bushes. A detailed study of this feature is in progress.

Arising out of the above indication, a small-scale trial with potash application to the soil has been started, though it seems more likely that the defoliating bushes are unable to make use of the potash rather than there being a shortage of it in the soil. Injection of a potash salt into the bush would probably provide a more satisfactory answer and attempts are being made in this direction.

4. *Other Pests and Diseases.*—Other pests and diseases were not troublesome during the year though attacks of Thrips on some Estates in the Nilgiris continue to cause concern and call for devising a suitable control measure. Diplodia, the Internal Root Disease of Tea, was reported from an unusually large number of Estates, particularly from those in the Wynaad where ' defoliation ' was prevalent.

Plant Protection Equipment and formulations.—Several types of equipment for spraying and dusting, including power-driven machines, were tested during the year and the Department is now in a position to suggest suitable equipment for various uses for which they are required. Several plant protection formulations were also tested, but shortage of staff has precluded trials being made with a larger number of the newly developed formulations of which samples are constantly being received.

Acknowledgements.—It is once again a great pleasure to record appreciation of the assistance received from members of the Scientific Sub-Committee and from the Secretary and staff of the U.P.A.S.I. Head Office in administrative work.

The Agents and Managers of Estates have, as usual, extended co-operation in the conduct of field experiments. To them and particularly to Messrs. A. V. Thomas & Co., Ltd., and Messrs. Malayalam Plantations Ltd., who offered accommodation and facilities for the Entomologist in connection with *Helopeltis* control operation carried out in Central Travancore, our special thanks are due.

The monthly Blister Blight returns compiled and sent by secretaries of District Planters' Associations have been of the greatest value and their co-operation is gratefully acknowledged.

Acknowledgement is also made of the help received from the Agricultural Research Institute, Coimbatore, by way of loan of books and identification of specimens forwarded to them from time to time.

The list of acknowledgements will not be complete without a reference to Managers of Estates visited to whose help and hospitality the members of the staff are greatly indebted.

S. ANANDA RAU,
Ag. Tea Scientific Officer.

METEOROLOGICAL

1948-49

Months	Rainfall in Inches.	No. of days with Rain.	Temperature				Humidity		Vapour Pressure		Cloud	
			Air		Soil *							
			Average noon Maximum.	Average overnight Minimum	8.30 A.M.	3.00 P.M.	8.30 A.M.	3.00 P.M.	8.30 A.M.	3.00 P.M.	8.30 A.M.	3.00 P.M.
April 1948	7.20	12	85.3	64.3	79.5	91.9	87.7	63.8	22.8	22.5	4.3	4.3
May ,,	5.51	13	81.8	66.0	78.2	88.9	86.7	75.0	23.0	24.8	5.4	4.4
June ,,	16.19	22	75.4	65.6	72.8	83.8	90.4	83.8	22.4	23.2	6.6	5.9
July ,,	11.25	29	73.4	65.0	73.2	77.7	92.7	87.8	21.8	22.7	5.8	5.6
August ,,	14.21	29	73.9	64.4	73.1	77.6	96.4	88.9	21.8	22.9	4.7	4.4
September ,,	5.00	18	76.6	62.6	73.7	80.0	91.5	80.3	20.8	22.5	5.2	3.5
October ,,	2.56	7	79.5	62.8	74.8	81.5	92.8	71.7	22.1	21.8	4.0	..
November ,,	3.70	16	79.0	63.4	74.0	78.8	91.3	73.1	21.8	21.9	7.0	5.6
December ,,	..	..	77.7	58.6	69.8	75.6	92.8	58.4	18.8	17.5	..	3.8
January 1949	..	..	80.5	57.0	68.4	76.6	87.3	37.5	15.6	12.5	..	..
February ,,	..	..	85.0	58.8	73.2	84.7	87.8	37.7	17.7	14.3	..	..
March ,,	..	..	87.9	61.3	79.4	92.8	79.0	43.1	18.9	16.9	..	..
Total ..	65.62	146										

*at 1 foot depth.

For the second year in succession the rainfall was below average. It was even less than that of last year by 1.15″, and the number of rainy days exceeded last year's figure by only 2. The drought was very prolonged and severe, there being no rain for 123 days from 29th November 1948. The relative humidity during the afternoons of January, February and March was markedly low, as in last year.

REPORT OF THE ENTOMOLOGIST

1948-49

The year under report was devoted almost exclusively to work on *Helopeltis* control in Central Travancore. Through the courtesy of Messrs. A. V. Thomas & Co., Ltd., accommodation and facilities for work were provided by Arnakal Estate where I was stationed for a period of 10 months from the beginning of the year to end of January 1949. From October 1948, I was in additional charge of the duties of the Tea Scientific Officer.

Advisory.—Correspondence relating to the entomological section numbered 284 letters received and 259 despatched. These represent a substantial increase over those of the previous year and arose mainly on account of *Helopeltis* work. Apart from *Helopeltis* in Travancore and an epidemic of Faggot-worms on an Estate in Nilgiri-Wynaad, no other serious pest of tea, shade trees or green manure plants came under notice.

Touring.—10 Estates in Central Travancore, one estate in South Travancore and 3 Estates in Nilgiris were visited during the year. Of the 10 Estates in Central Travancore, one was visited at frequent intervals in order to make observations on the large-scale *Helopeltis* control operations undertaken by the Estate. In addition, 3 visits were made to Coonoor, the first for discussions with Mr. Manning prior to his departure, the second and third for administrative reasons in the capacity of Acting Tea Scientific Officer.

I also attended the budget meetings held in Coonoor in March 1949.

Publications.—A preliminary report on *Helopeltis* trials carried out in South Travancore in 1947 was published in the 'Planters' Chronicle', Vol. XLIII, No. 8, April 15, 1948.

HELOPELTIS

Encouraged by the results of preliminary trials with DDT dusting carried out in previous years, further extension of work was planned and carried out during 1948-49. This included fairly large-scale field trials on Arnakal Estate directly under the writer's supervision and a whole estate dusting programme which another estate in Central Travancore undertook to carry out. It is proposed to make a full report on this work in a separate publication and only a brief outline of these trials and the results obtained are given below.

Trials on Arnakal Estate.—It was originally intended to carry out dustings on a 50-acre block of tea, but as one area of that size and suitable for the trial was not available on the Estate, 3 areas of about 20, 16 and 5 acres respectively in different fields were selected for dusting. These areas, according to local experience, were subject to severe *Helopeltis* attacks year after year in the past. Two dustings with an interval of a fortnight between them were made in April-May and one or two according to requirements in the post-monsoon period. The dusts applied were 50% DDT formulations obtained from several sources and reduced to 3% and 4% by mixing with China clay locally in a rotating drum-type mixer. Details of the DDT and 'filler' used, procedure adopted in mixing,

the timing of applications and approximate costs are explained fully in the article published in the Planters' Chronicle Vol. XLIII, No. 18, September, 15, 1948.

Trial Area No. 1 was an isolated 5-acre field which was surrounded on all sides by grass land and jungle. The first and second rounds of dusting were made on 7th May and 20th May respectively. Fresh attack by nymphs hatching subsequent to dusting was noted on a small number of bushes after the first round, but not after the second round. The area remained completely free for 7 weeks after which signs of attack on odd bushes began to appear and by the middle of August over a 1,000 bushes, mostly at one end of the field, revealed infestation. The third dusting was made on 10th September and no further attack was noted until November and the area was in excellent flushing condition in October and maintained satisfactory position in November. In November, a ' build up ' of the insect population was again observed and this increased until the middle of January after which the pest showed signs of declining. The attack in December and January was light with negligible crop loss in comparison with the rest of the Estate which experienced severe attack and consequent loss of crop at this time of year. A fourth round of dusting towards the end of November or early December could usefully have been undertaken, but weather conditions prevailing then did not permit of this being done.

Trial Area No. 2 was a 20-acre field which was dusted twice in April/May. Apart from fresh bites noted on a few bushes a few days after the first dusting and before the second round, the area remained completely free until the end of August. Light attack on scattered bushes occurred in September, but did not call for a third round of dusting. In October, a general increase was noted and this was dealt with by a third application of the dust on 5th-8th October. Towards the second half of November, a further infestation took place in one section, mainly as a result of infiltration from an adjoining field pruned at the time. This section was dusted for the 4th time on 30th November and remained practically free throughout December and January when the pest activity was on the increase in that part of the trial area which had not received the 4th round of dusting.

Trial Area No. 3 which was about 16 acres in extent, remained the least infested of the three areas throughout the period of the experiment. Two dustings done in April/May eliminated what little infestation there was in the field and fresh bites were not noted until the end of August. In September and October, the attack was only light and confined to scattered bushes. Even in November the attack was very much restricted, but having regard to the general increase which had taken place in other areas and the district generally, half this area was treated to a third round of dusting on 29th November. The dusted part responsed remarkably to treatment and was in good flushing condition in December and January. The pest in the area as a whole was comparatively mild throughout the period of the Experiment and the area suffered little or no crop loss at any time.

Large Scale Dusting of whole Estate.—This large scale campaign of dusting was undertaken by Messrs. Malayalam Plantations Ltd. on one of their Estates in Central Travancore in which the Scientific Department actively co-operated. The work carried out consisted of two trials in one of which 250 acres of tea were treated to full-scale dusting with hand machines while in the other, which also covered 250 acres, drift cloud (barrier) dusting was done from existing cart roads by means of a power dusting machine. The dust used was 3%—4% DDT in China clay, locally mixed, together with 1%—1½% Gum Acacia as sticker. In both the trials, 2 dustings were made in April/May before the onset of the monsoon and the third dusting at the end of September.

In the full-scale dusting trial, the entire area remained practically free until August after which slight increase in activity was noted until the end of September when the third dusting was made. About the middle of November, signs of renewal of pest activity began to be noticed once again and the increase in the number of attacked bushes continued until about the middle of January when the pest began to decline. At no time during the pest season, did the bushes go ' black ' with the pest, as is usually the case at the height of attack, and the pest, on the whole, inflicted very little damage or loss of crop. The green and healthy appearance of dusted fields in comparison with those of neighbouring Estates in November and December was ample testimony to the value of dusting.

The results of drift cloud (barrier) dusting trial were not nearly so satisfactory. The area which received this form of dusting revealed more attack throughout the season and there was evidence of some loss of crop occurring after December. The reasons for the less satisfactory results in this trial are probably the relatively lower rate of application of the dust per acre and also differences in the settling rates of DDT and China clay when the mixed dust is blown through the power dusting machine. This latter point is discussed later in the report.

Modifications in the suggested timing of Applications.—From observations made on the seasonal trend of the pest in Central Travancore and in the light of experience gained from trials carried out in 1948, there is reason to believe that the original plan of 2 dustings in April/May and one in September/October could advantageously be modified. Under normal conditions the pest in Central Travancore does not seem to get a real start until about the end of August and its season will last until about the end of January. It would therefore appear that, from a practical control point of view, 2 dustings in April/May are probably superfluous and a single dusting in September/October insufficient. A better plan would be to double dust 'pockets' only in April/May and to carry out 2 rounds of full-scale dusting during the post-monsoon period in September/October in order to secure greater protection until the end of the season. Weather conditions may be a difficulty during the post-monsoon applications, but under normal conditions, one can reasonably expect to get suitable weather for a period sufficient to complete the dustings. By this procedure, it would appear possible to cut out one round of dusting without adversely affecting the efficiency of the control operations.

The above modifications do not, however, apply to South Travancore where even in May severe attacks are usually experienced. For that district it is suggested that the original programme of 3 dustings be adhered to and that provision be also made for a fourth round which might become necessary in the post-monsoon period.

Equipment.—Several types of hand machines and two power machines were tested during the trial operations. Among the former, the rotary types were found more suitable. For large scale operations power dusting offers distinct possibilities as, by making full use of drift, it should be possible to achieve reasonable degree of control. There is, however, still need for improving the efficiency of dusting by this method in view of the indications of possible separation of the dust mixture while dusting.

Cost of Dusting.—The actual figures have not been worked out, but as a rough estimate, the cost of dusting in our trials was in the neighbourhood of Rs. 8 per acre per application. There is considerable scope for reducing this figure

substantially, especially as the removal of import duty on insecticides has brought down the cost of DDT from Rs. 4 to a little under Rs. 2 per lb. now.

Settling rate of DDT and China Clay.—That small differences existed in density and particle size between the DDT and China clay was recognised even in the beginning. Although chemical analysis revealed that homogeneous mixture of the two in desired concentrations could be secured by local mixing, it was felt desirable to make sure that a separation did not take place during the process of dusting. In order to test this, the locally mixed DDT dust was put through a crank duster and the settling dust collected at every foot over a distance of 11 feet. Two tests were made on different occasions and figures of analysis of the DDT content in the settled dust are tabulated below.

Dust settling at:	Test 1. (With 2.73% DDT dust) % D.D.T.	Test 2. (With 2.81% DDT dust % D.D.T.
0 — 1 ft.*	..	..
1 — 2 ,,	10.01	9.53
2 — 3 ,,	8.19	7.84
3 — 4 ,,	7.34	6.32
4 — 5 ,,	6.42	5.38
5 — 6 ,,	6.20	5.03
6 — 7 ,,	5.92	4.45
7 — 8 ,,	5.12	3.98
8 — 9 ,,	4.44	3.39
9 —10 ,,	3.75	3.28
10 —11 ,,	3.52	2.57

* not analysed as very little dust settled.

It will be seen that the two tests show approximately the same trend. The dust settling at the second foot from the machine had the highest concentration of DDT which progressively decreased as the distance from the machine increased. While the above feature is not a serious factor in dusting with hand machines,—in fact it is perhaps an advantage,—it is considered that, should a similar separation occur in the power machine, it may militate against its efficient use as the cloud drift beyond a certain range, in addition to wider dispersion, will have too low a concentration of DDT to be toxic to the insect. Studies are being made as to how best to overcome this difficulty and it is felt that if the DDT concentrate and China clay could be made uniform, at least in respect of particle size, the chances of separation taking place will be reduced to a large extent.

Further Lines of Work.—The results of trials so far made indicate the need for further work on the following aspects.

1. Timing of applications in Central and South Travancore.
2. Increased concentration of DDT and lower rate of application.
3. 'Sticker' problem.
4. Means to overcome the possible separation of DDT from the 'filler' in power dusting.

Use of other formulations of DDT.—One or two estates in Central Travancore have also done spraying on a small scale with DDT suspension and emulsion and report favourably on these formulations.

Trials with Benzene Hexachloride (BHC)

(*a*) *Dust.*—BHC 50% NT dust from which the tainting property was said to have been removed was supplied by Messrs. Imperial Chemical Industries (India) Ltd., for trial purposes. It was diluted to 3½% by local mixing with China clay in the same manner as DDT dust and the toxity tests made at this strength both in the laboratory and in the field indicated that the product was toxic to *Helopeltis*. In the field, despite considerable improvement in the pest position and a remarkable growth of flushing points noted over a period of few weeks after dusting, reinfestation of the dusted area was observed to occur much sooner than with DDT, thus indicating a shorter period of residual effect.

In order to determine the taint question, the 3½% dust was applied to an area of good flushing tea with a view to secure at one plucking sufficient leaf for a roll. The area was plucked 3 days after dusting and the leaf manufactured separately. The tasters to whom samples were sent, although not reporting any definite taint, classed the sample of dusted tea as inferior to that of the check sample which was manufactured from leaf from the same field.

(*b*) *Wet Spray.*—BHC 50% Wettable Powder, also claimed to be non-tainting, was tried as a wet spray in comparison with DDT 50% Wettable Powder. Both formulations were sprayed at the same strength of 1% i.e., 1 lb. in 10 gallons of water. The design of the experiment was a randomised block lay-out with 8 replications of each treatment. Each plot consisted of 300 bushes. The sprays were applied on 16th/18th December 1948 and observational data are tabulated below.

Number of attacked bushes.
(in 2400 bushes under each treatment)

Treatment	Dates of observation					
	Dec. 25	Jan. 3	11	17	24	31
DDT. ..	5	5	15	8	5	11
BHC ..	148	338	478	399	282	211
Control ..	1,068	1,139	1,117	912	812	634

Number of attacked shoots in 800 shoots
sampled at each plucking round before and after spraying.

Treatment	Dates of Plucking					
	Dec. 15	22	30	Jan 7	18	28
DDT. ..	157	94	2	7	5	6
BHC ..	164	107	78	92	75	62
Control ..	139	143	221	213	164	132

On the basis of the above trials, the indications are that BHC, whether as dust or as wet spray, is inferior to DDT in the control of *Helopeltis*.

Combination spray Experiment.—This experiment was carried out in Central Travancore in order to determine whether a spray combining both an insecticide and fungicide would be useful against both *Helopeltis* and Blister Blight at the same time. Perenox and DDT (wettable form) were used, alone and in combination, the former at a strength of 2 oz. in 10 gallons and the latter at 1 lb. DDT 50% Wettable Powder in 10 gallons of water. The trial area consisted of 32 plots, each of 300 bushes, and 4 treatments, viz., Perenox only, Perenox plus DDT, DDT only and control, were replicated 8 times. The treatments were applied twice, the first on 12th/17th May and the second on 28th/31st May.

Contrary to expectation *Helopeltis* was confined only to odd bushes and did not increase to any appreciable extent during the few weeks following spraying so that the effect of the treatments on this pest could not be satisfactorily evaluated. As regards blister blight, the results are discussed under the head "MYCOLOGICAL" and it need only be mentioned here that indications were obtained that Perenox and DDT are compatible. The incidence of blister on the plots sprayed with Perenox only and in those sprayed with Perenox plus DDT was more or less of the same order and definitely less than in plots sprayed with DDT only and of the control. A further point worthy of note in this experiment is that the stimulating effect of DDT on growth noted in the earlier spraying and dusting experiments was not observed. The reason for this, presumably, is that the severe incidence of Blister Blight which took place almost immediately after the treatments were applied masked this feature.

EELWORM

Having been away from the Station almost throughout the year in connection with *Helopeltis* work in Central Travancore, no further work on this problem was undertaken. Examinations of soils and weeds from prospective nursery sites were, however, attended to as part of advisory work. Since returning to the Station early in 1949, a replicated trial on tea nursery beds has been started to test the effect of Dowfume-N, a soil fumigant, on the root-knot eelworm. The fumigant was applied at two doses a fortnight before putting out the germinating seed on the beds. It is too early to report on this trial.

OTHER INSECT PESTS

Noteworthy among the enquiries received during the year are an epidemic of Faggot-worms, *Clania crameri*, on tea and an attack of the Scolytid borer, *Xyleborus noxius* Sampson, on Grevillea. The former was reported in January 1949 from an estate in Nilgiri-Wynaad where it has appeared in such large numbers that over 200,000 insects were collected and destroyed in the course of 3 weeks. Systematic hand-picking appeared to have brought the pest under control.

Xyleborus noxius Sampson was reported from the Anamallais as causing widespread damage to Grevilleas. The trees which had been rung as a measure of Blister Blight control and subsequently healthy trees appear to have been badly infested and fears were expressed that the entire stand of Grevilleas on the Estate may eventually be killed out. General experience of this type of borers is that they attack trees rendered unthrifty as a result of other causes and on going into the question of possible predisposing factors, it became evident that the trees were over 35 years old which is an age at which it is probable their vigour is much reduced and the trees have outlived their usefulness. There was also some evidence to suggest that the attack was associated with elevation, the trees at a lower elevation being more subject to attack than those at a higher elevation.

Acknowledgements.—It is a pleasure to record here my grateful appreciation of the assistance given by Mr. W. S. Scott, Manager, Arnakal Estate, during the period of my stay on Arnakal Estate. Grateful acknowledgement is also made of the hospitality received from Managers of Estates visited during the year. I must particularly mention in this connection the help and courtesies received from Mr. D. M. Marr of Arniekudy Estate during the several visits made to him in connection with the dusting trials.

S. Ananda Rau,

Entomologist and Asst. Tea Scientific Officer.

MYCOLOGICAL
1948-49

The Department had no Mycologist on the staff during the year and the work of this section, including advisory work, was carried out by other members of the staff. Accounts relating to mycological subjects are to be found in other sections of this report, but an attempt is made to bring together and present in this section the results of all experiments carried out in connection with Blister Blight.

BLISTER BLIGHT

Spraying Trials—1947 Pruned Tea (V. J.).—This trial was started in May 1947. The details of the trial and yield figures from the sprayed and unsprayed plots up to the end of March 1948 were given in last year's report. Recording of yield data was continued till the end of September 1948 and for the sake of reference the complete yield figures from the time recording started are tabulated below.

TABLE 1

Yield in lbs. green leaf

Month	*Sprayed*	*Unsprayed*
November 1947.. ..	66	..
December ,, ..	..	..
January 1948	117	27
February ,, ...	84	25
March ,, ...	143	65
April ,, ...	84	42
May ,, ...	347	245
June ,, ...	183	131
July ,, ...	223	197
August ,, ...	264	237
September ,, ...	158	147
	1,669	1,116

It may be mentioned that spraying started from the last week of August 1947 at ten-day intervals and was discontinued after the last week of December 1947. In all, 12 rounds of spraying were done. It will be seen from the above table that the sprayed plots continued to give distinctly higher yields till the end of June 1948 after which the difference narrowed down till at the end of September 1948 it was negligible. That the spraying given during the vulnerable period after pruning has protected the bush from disease to a very large extent even during the succeeding year is very evident from the above figures. During the course of eleven months, the sprayed plots gave 50% higher yield than the unsprayed.

Spraying Trials—1948 Pruned Tea (V. J.).—In the same area mentioned above, another experiment was started during the current year to compare two strengths of Perenox spray, viz., 2 ozs. and 4 ozs. in 10 gallons of water. The plots skiffed last year were pruned to 26″ without any cleaning, during the first week of June 1948. From the time of bud break in the first week of July 1948, half plots were sprayed at the above strengths at 10-day intervals till the first

week of January 1949. The quantity of spray fluid used averaged 72 gallons per acre and the number of men employed 3 per acre. The plots were tipped during the first week of September 1948. In addition to recording the yield data from the plots it was decided to examine the intensity of infection of the disease in the different plots. For this purpose, after each plucking round, 100 shoots from each plot were chosen at random, examined and scores given as follows :—0—no blisters; 1—infection very slight with very few blisters on the leaf; 2—large number of developed blisters on the leaf; and 3—large number of developed blisters on the leaf and stalk. The yield data and score figures are given in the table below.

TABLE 2

Percentage of shoots in each category (average of 14 plots) and yield in lbs. green tea leaf (total of 14 plots)

	2 ozs.					4 ozs.				
Date	0	1	2	3	Yield	0	1	2	3	Yield
2- 9-48	33.6	49.6	14.9	1.8	34	42.8	41.3	14.4	..	35
30- 9-48	88.5	11.5	..	..	14	84.7	15.3	..	..	13
22-10-48	91.7	8.3	..	..	197	89.1	10.9	..	..	160
9-11-48	88.1	11.9	..	..	153	87.6	12.4	..	..	158
23-11-48	76.7	21.1	2.2	..	43	77.8	20.0	2.0	..	50
7-12-48	72.3	24.7	3.0	..	27	74.4	23.8	1.8	..	30
16-12-48	78.2	21.0	0.8	..	40	74.2	24.2	1.6	..	42
27-12-48	93.3	6.7	..	..	82	88.0	12.0	..	..	77
11- 1-49	100.0	..	..	..	74	100.0	..	..	..	79
			Total	..	664			Total	..	644

The difference in yield between the two treatments is negligible, indicating that 2 ozs. of Perenox in 10 gallons is as effective in protecting the bush from the disease as 4 ozs. The severity of infection is also almost the same in both treatments. There was practically no stalk damage (score 3) and the shoots showing large number of developed blisters on the leaf (score 2) were few. Except when the disease showed marked increase during the latter half of November and first half of December, only few blisters (score 1) developed on the leaves. It would thus appear that a strength of 2 ozs. of Perenox in 10 gallons of water may effectively be used for spraying against Blister Blight.

Spraying and Dusting Trial—Bed Nursery. (V.J.).—To study the effect of spraying and dusting against Blister Blight, a trial was started in the same bed nursery on a neighbouring estate as mentioned in the last year's report. There were five treatments replicated six times. The treatments were : (1) No treatment, (2) Perenox spray at 2 ozs. in 10 gallons of water, (3) Perenox spray at 4 ozs. in 10 gallons of water, (4) Perelan 1 dust at 8 lbs. per acre, and (5) Perelan 1 dust at 16 lbs. per acre. The treatments were begun from the last week of June and continued at weekly intervals till the end of January 1949. In each bed, 100 seedlings (10 × 10) were marked off with stakes for taking infection counts. After the treatments were over, weekly counts of the number of plants infected and the number of leaves infected in each plant were recorded for the 100 plants in each bed. The infected leaves were always picked off the plant. To prevent the dust from being carried away by wind, a box-like frame 3′ × 3′ × 1½′ was held above the plants while dusting. The dusting was carried out very early in the morning

when, due to the absence of wind and presence of dew on the leaves, the dust adhered to the leaves well. The results obtained are represented in the graphs 1 and 2 appended. The following table gives the number of infected leaves removed from 600 plants of each treatment over a period of 28 weeks :—

TABLE 3

No treatment	Perenox		Perelan 1	
	2 ozs.	4 ozs.	8 lbs.	16 lbs.
Total number of infected leaves 5,470	1,394	1,301	3,226	3,057

The results indicate that (1) the severity of the disease was not so great as during the previous year, (2) the spraying has given 75% protection from the disease, (3) the difference between the two strengths of spray is negligible, (4) spray is distinctly more effective than the dust, (5) dust at 16 lbs. is somewhat better than at 8 lbs. and (6) the number of blisters found on the leaves of the sprayed plots was considerably less than the number on leaves of the unsprayed plots.

Plucking Systems in Relation to Blister Blight Attacks (S.A.R.).—The object of this experiment was to determine the effect of different types of plucking on the incidence of Blister Blight and crop, as it was considered that plucking is likely to be one of the major 'agricultural' methods of mitigating the ravages of the disease. A plot trial on a randomised block design was started in May 1948 on an area of tea pruned in December 1947. The plots consisted of 300 bushes each and 8 replications were made. Three types of plucking were adopted as follows :—

1. Plucking rounds of 6 days, the plots plucked to a horizontal 'table', but only fully mature flush removed. This treatment involved a medium-coarse or light plucking.

2. Plucking round of 7 days, the plots plucked to a flat 'table', the table being maintained to a level by plucking all flush above the level. The level is then raised by 2" (one leaf) every 3 months by throwing out of plucking for 2—3 rounds. This type involved hard plucking but provided for the establishment of a new old-leaf canopy by raising the plucking level 2" every 3 months.

3. Plucking round of 8 days, the plots plucked normal-medium as in estate practice, maintaining a horizontal plucking surface.

The trial was run for a period of 9 months on an Estate in Central Travancore and the data are summarised below.

Incidence of disease.—The recordings of percentage infection in plucked shoots made at each plucking round are given in the accompanying graph (Fig. 3).

Yield.—The total crop figures, in lbs. green leaf, from May 1948 to end of January 1949 are given in the following table :—

TABLE 4.

	Crop (in lbs. green leaf)
'Light' plucking ..	1,248
'Medium' ,, ..	1,347
'Hard' ,, ..	1,008

Difference required for significance (P=0.05)=225 lbs.

It will be seen from the graph that the incidence of disease under ' hard ' plucking is apparently less than under the other systems of plucking. The difference, however, is small and can hardly be looked upon as an advantage, especially as ' hard ' plucking has adversely affected crop. The difference in crop between this type of plucking and the two others is statistically significant. Although continued hard plucking is definitely not favoured, results of this experiment cannot be taken to mean that hard plucking over a short selected period in the middle of the Blister Blight season would not be justified.

Combination Spray Trial (S.A.R.).—The object and lay-out of this trial are discussed in the Entomologist's Report under '*HELOPELTIS*'. It only remains to discuss here the effect of the combination spray on Blister Blight. As already indicated, the mixture of DDT with Perenox did not detract the value of the latter. The percentage infection and yield data are tabulated below :

TABLE 5

Percentage Infection

	May		*June*				*July*			
	10	24	1	9	16	24	1	9	23	30
Perenox ..	9.3	8.8	26.4	29.3	37.3	78.5	88.3	82.4	55.4	31.8
Perenox plus DDT	9.4	13.6	22.6	27.8	32.9	88.4	92.6	85.1	59.9	31.4
DDT. ..	7.5	14.1	34.1	58.1	74.5	96.8	96.1	83.5	38.5	22.3
Control ..	10.9	15.1	44.9	63.1	83.6	98.5	98.0	81.8	42.5	23.3

TABLE 6

Yield (in lbs. green leaf)

	May (part)	June	July	August
Perenox ..	175	542	101	458
Perenox plus DDT ..	165	536	100	501
DDT. ..	166	512	53	579
Control ..	173	489	50	584

From the percentage infection figures it is clear that two rounds of spraying have not helped materially to keep the disease in check but that peak attack was postponed by about a fortnight. It is significant, however, that in July, when the attack was at its height, the Perenox plots gave higher yields but that in August, when the disease declined, the non-Perenox plots gave substantially higher yields, thus wiping out the superior performance of the Perenox plots in the earlier months.

Tipping Experiment (V. J.).—A trial to test the merits of two heights of tipping on the incidence of Blister Blight was started in the 1926 planted tea on the Experimental Station during the year. The tea was pruned to 26″ during the third week of November 1948 and tipped at 3″ and 6″ during the first week of February 1949. There are eight plots in each treatment. It is intended to examine the leaf from each plot for severity of infection during the coming Blister Blight period.

S. ANANDA RAU,

Ag. Tea Scientific Officer.

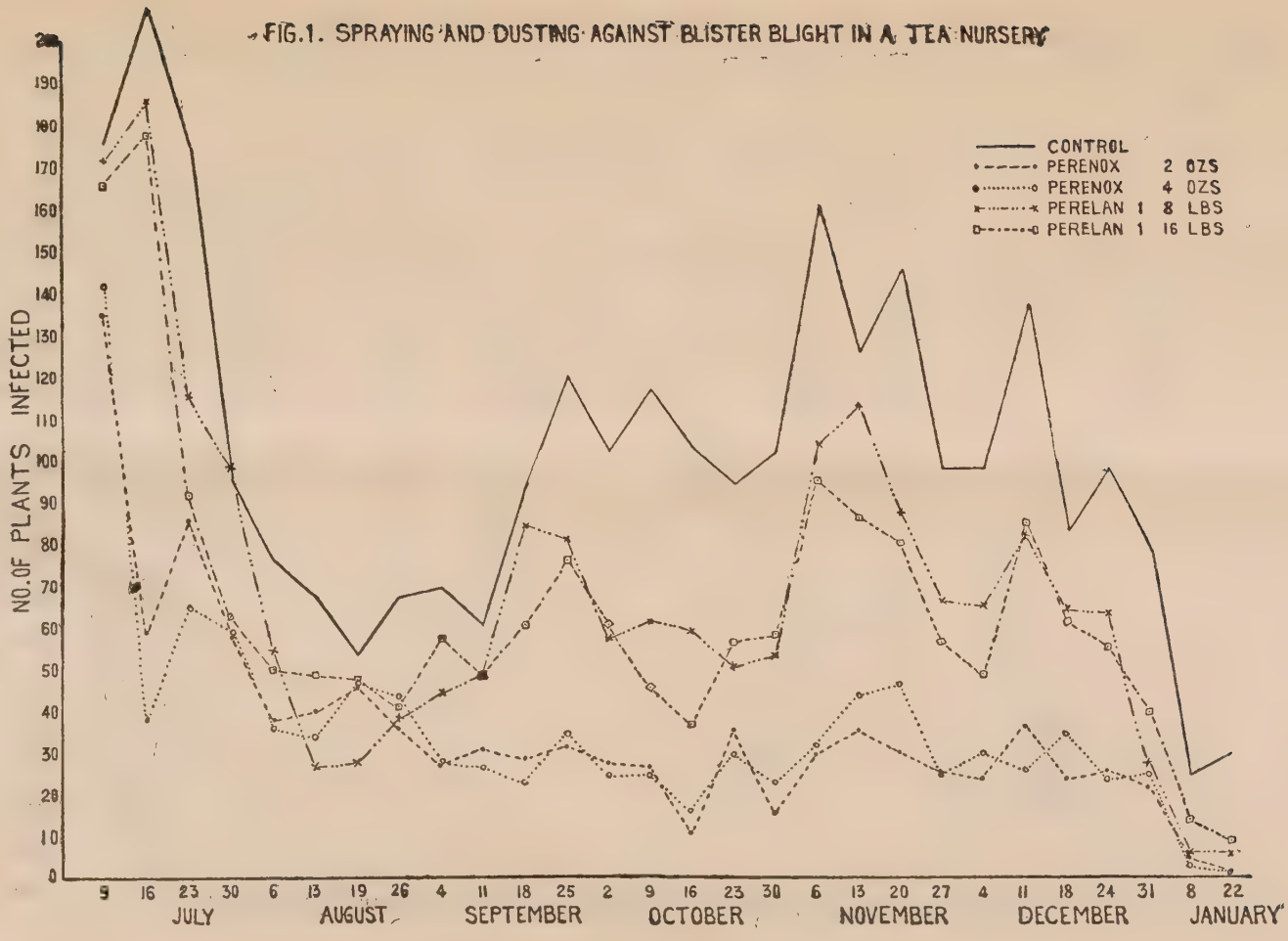


FIG.1. SPRAYING AND DUSTING AGAINST BLISTER BLIGHT IN A TEA NURSERY
CONTROL
PERENOX 2 OZS
PERENOX 4 OZS
PERELAN 1 8 LBS
PERELAN 1 16 LBS
NO.OF PLANTS INFECTED
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
9 16 23 30 6 13 19 26 4 11 18 25 2 9 16 23 30 6 13 20 27 4 11 18 24 31 8 22
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
JANUARY

FIG.2. SPRAYING AND DUSTING AGAINST BLISTER BLIGHT IN A TEA NURSERY

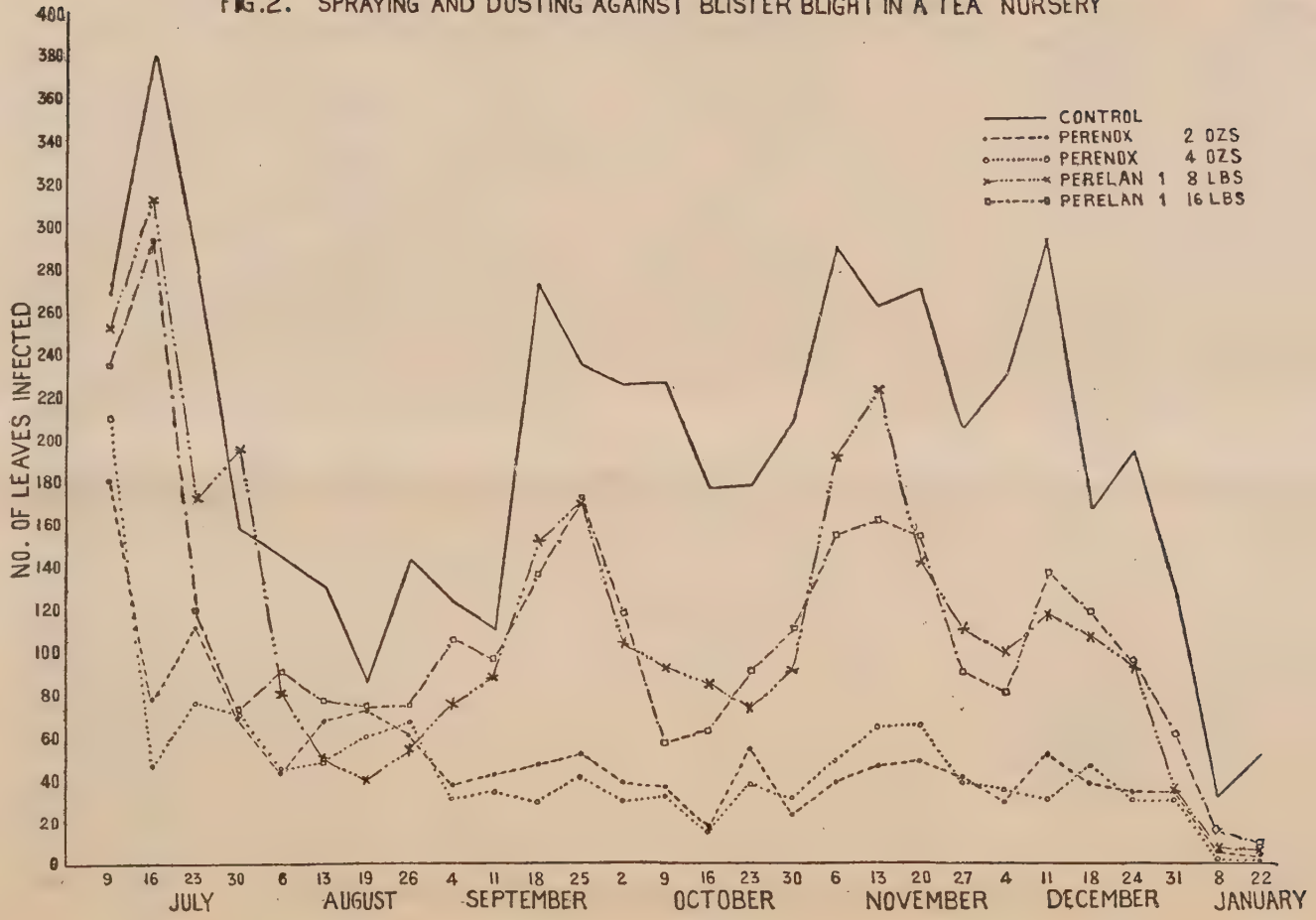
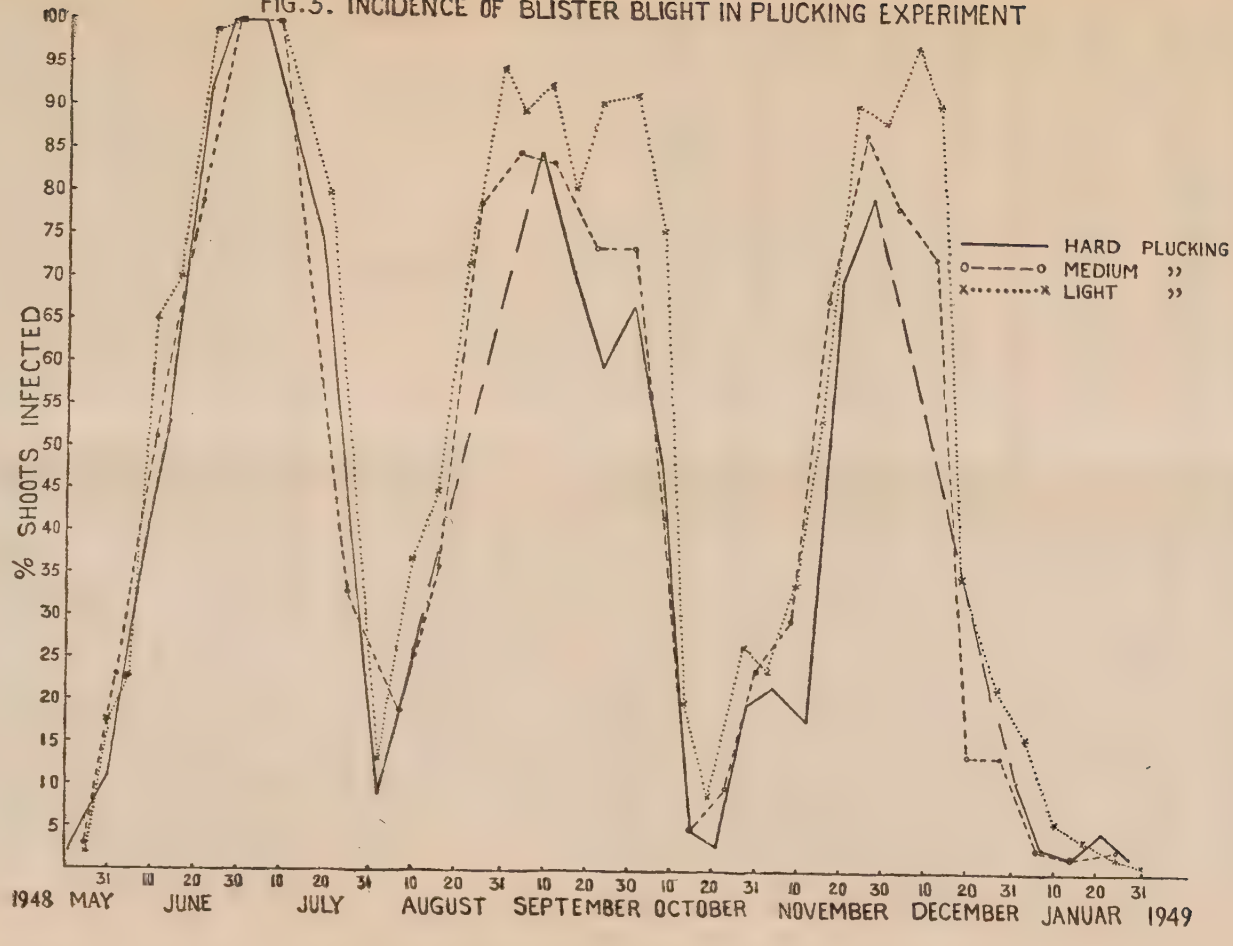


FIG.3. INCIDENCE OF BLISTER BLIGHT IN PLUCKING EXPERIMENT



REPORT OF THE SOIL CHEMIST

(1948-49)

Administration.—I was in charge of the Station till the return of the Acting Tea Scientific Officer in February 1949.

Touring.—The following visits were made in connection with spraying and dusting trials against Blister Blight, manurial experiments, ' defoliation ' of tea and administrative work :—

(1) weekly, to a bed nursery on a neighbouring estate for spraying and dusting trials against Blister Blight ;

(2) fortnightly, to a pruned tea area on another neighbouring estate for spraying trials against Blister Blight ;

(3) to the manurial and cultivation experimental area on an estate in the Nilgiris during November ;

(4) to a neighbouring estate for lime sulphur spraying against Red Spider and ' defoliation ' and for examination of defoliated area ;

(5) to an estate in Nilgiri-Wynaad to suggest improvements for a weak patch of tea ; and

(6) to Coonoor thrice, once for the Annual General Meetings and Exhibition and twice to meet the Tea Scientific Officer.

Advisory.—In connection with advisory work a number of samples of soils, manures, manure mixtures and composts were analysed. The details of these are tabulated below :

Soils :	
Complete analyses	9
Nitrogen, Organic matter, Mechanical analyses and pH	11
Nitrogen, Organic matter and pH ..	6
Organic matter and pH	26
Composts	18
Manure and manure mixtures ..	14

In addition, 24 mycological specimens were examined and reported on.

Majority of the soil samples analysed were received from areas wherein tea had become thin and defoliated. These soils were found to be more or less typical of the districts from which they came and the analytical figures with regard to nitrogen, organic matter, physical texture and reaction did not show any wide divergence from those of a typical soil. In fact, some were even rich in organic matter and nitrogen. The remaining soil samples were from Coffee, Cardamom and Rubber areas.

As a matter of interest it may be mentioned here that a sample of jungle soil showed a loss on ignition figure of 28.24% and a nitrogen content of .7%. Similarly, a sample of compost made from lemon grass after extraction of oil was found to be very rich in organic matter (loss on ignition—62%) and nitrogen (2.73%).

All the manures and manure mixture samples were found up to guaranteed analysis.

General enquiries relating to manuring of tea and rubber, resting of defoliated tea, eelworm, spraying against Blister Blight, and phosphatic manures were attended to.

Blister Blight.—The following experiments were carried out during the year :—

1. Spraying trials in pruned tea—started in 1947.
2. ,, ,, ,, ,, 1948.
3. Spraying and dusting trials in bed nursery—started in 1948.
4. Trial on tipping heights—started in 1949.

Details and results of these trials are given in the Mycological section.

Defoliation.—It was mentioned in last year's report that two trials, one on the Station and the other on a neighbouring estate, were undertaken in order to find whether Red Spider and other mites influenced defoliation of tea. On the neighbouring estate, the first spraying with lime sulphur was made in the middle of March and the second in the middle of May. There were three treatments—(1) no spray, (2) lime sulphur 1 in 18, and (3) lime sulphur 1 in 36, replicated six times. The area was visited four times, in April, May, June and December and scores given to 12 random bushes in each plot selected and staked at the start of the experiment. The bushes were classified according to the extent of defoliation and it was found that out of the 216 bushes examined 168 remained in the same condition, 36 deteriorated and 12 improved.

Similarly, on the Station 10 bushes in each of 5 categories (vide last year's report, p. 13) were selected and staked. The bushes were sprayed with lime sulphur at a strength of 1 in 18 in March and again in May. The results of examination of the bushes in the following February were as follows :—

Category	Original	Final
1.	10 bushes	6 in category 1 and 4 in category 2
2.	10 ,,	5 in category 2 and 5 in category 3
3.	10 ,,	9 in category 3 and 1 in category 4
4.	10 ,,	8 in category 4 and 2 in category 3
5.	10 ,,	6 dead, 1 in category 5 and 3 in category 4

While some of the healthy bushes remained in the same category (1), others had deteriorated to the next category. There was a slight improvement in 2 bushes in category 4 and 3 bushes in category 5. In general, lime sulphur did not appear to have resulted in marked improvement in the defoliated bushes.

In conjunction with the Botanist, the following small-scale trials have been started : (1) Selected bushes were pruned and a caustic wash given, to find how bushes in different stages of 'defoliation' react to pruning and in what stage of the cycle 'defoliation' actually starts. (2) Watering bushes during the dry weather to test whether lack of moisture is the cause of 'defoliation'. (3) A small area of bushes has been heavily mulched. This area will be deep forked in June and again mulched after the North-East rains. This treatment will be repeated every year during the next pruning cycle and the bushes examined periodically.

Vegetative Propagation.—On the Station, one bush has been found to be resistant to Blister Blight. This bush was pruned in June 1948 so as to expose

it to the full attack at tipping stage and after confirming that it was completely resistant, internodal cuttings have been taken for vegetative propagation.

Trial with Dowfume N.—In conjunction with the Acting Tea Scientific Officer, a replicated trial to test the effect of Dowfume N on the root-knot eelworm has been started in a bed nursery. The trial consists of three treatments, 0, 20 and 40 gallons of Dowfume N per acre, replicated six times. The tea seeds were put out in the beds during February 1949. A fortnight before this, the calculated quantity of the fumigant was applied at a depth of 6″ at spacings of 10″ and sealed off with soil. It is intended to examine the seedlings periodically for eelworm infestation.

DDT.—In connection with the dusting trials against *Helopeltis*, 35 samples of DDT were analysed for their DDT content. These samples consisted of proprietory products, locally mixed dusts and dust ejected from dusting machines. All the proprietary products were found up to the guaranteed analysis. Local mixing of the 50% DDT with China clay, to get mixtures of desired concentration was found to be quite satisfactory. When the 3% dust ejected from the dusting machine and settling at distances up to 11′ was analysed, it was found that the concentration of DDT in the dust settling nearer the machine was very high and that it decreased progressively with increasing distance. It would appear that this separation is due to the difference in relative density and particle size between DDT and China clay. Investigation on this subject is programmed for the ensuing year.

Field Experiments.—The yield data from the field experiments are given below. In calculating the figures of made tea per acre it has been assumed that 100 lbs. of green leaf would give 22½ lbs. of made tea except in the case of Korakundah where the estate outturn figure of 24.7% is adopted.

PLANT FOOD REQUIREMENTS

(A) 27 *plot* (3 × 3 × 3) *Factorial Experiments*

(1) *Tea Experimental Station* : The yield figures for the second year of the third cycle are tabulated in Table 1.

TABLE 1

Nitrogen ..	0 lbs.	40 lbs.	80 lbs.	
Yield ..	1019.5	1055.1	1407.6 lbs.	made tea/acre
Phos. Acid ..	0 lbs.	20 lbs.	40 lbs.	
Yield ..	1103.4	1172.1	1206.6 lbs.	,,
Potash ..	0 lbs.	20 lbs.	40 lbs.	
Yield ..	962.0	1158.3	1361.7 lbs.	,,

Difference required for significance (P = 0.05) = 266.4 lbs.

Nitrogen at 40 lbs. per acre failed to give significant response this year. It may be mentioned that during the second year of the previous two cycles this dose was significant.

Nitrogen at 80 lbs. has continued to increase the yield significantly. The yields during the year from the different treatments are less than those of the corresponding year of the previous cycle. This may be due to incidence of Blister Blight and ' defoliation '.

An interesting point arises this year in respect of the effect of potash. Application of potash at 20 lbs. and 40 lbs. per acre did not result in significant increase in yield during the past seven years of this trial. In the eighth year, the higher dose of potash has given increased yield significant at 5% level. It is worthwhile to mention two points in this connection. (1) In Ceylon, it has been found that after three cycles of manurial experiment, noticeable differences in yield between the potash plots were seen to develop during the fourth cycle. This was confirmed in the fifth cycle when both K20 and K40 showed significant increases over Ko. Although K40 was somewhat superior to K20 the difference between them was not of assured validity and it was concluded that for the present, 20 lbs. of potash per annum is adequately supplying the needs of tea. (The Tea Research Institute of Ceylon, Bulletin No. 28, p. 38.) In the present trial, only K40 is significant, in the eighth year. The common point of conclusion appears to be that omission of potash over a period of several years is likely to result in progressive depletion of soil potash. (2) As mentioned in last year's report, ' defoliation ' became prominent in most of the plots. In connection with the investigation of this problem, the Botanist examined the individual bushes in all the plots, giving scores to each according to the extent of ' defoliation '. Statistical analysis of the data thus obtained revealed that plots which had received no potash had significantly more ' defoliation '. Soil and foliage analyses are planned for the coming year.

(2) *Anamallais* (*Mudis*) *:* The area was pruned during the last week of October 1947 and the manures applied only during the first week of November 1948, i.e., after one year. Following are the yield data for the first year of the cycle :—

TABLE 2

Nitrogen	.. o lbs.	30 lbs.	60 lbs.	
Yield	.. 405.0	402.3	419.4 lbs.	made tea/acre
Phos. Acid	.. o lbs.	20 lbs.	40 lbs.	
Yield	.. 414.9	410.2	403.0 lbs.	,,
Potash	.. o lbs.	20 lbs.	40 lbs.	
Yield	.. 409.6	402.7	412.2 lbs.	,,

The differences are not significant. This is as expected since the experiment missed the manure application. There is no residual effect from the previous year's application.

(B) 48 *plot* (6×8 *Randomised block*) *Experiment*

Anamallais (*Mudis*) : The second year data are as follows :

TABLE 3

Nitrogen	.. o lbs.	40 lbs.	
Yield	.. 744.6	776.0 lbs.	made tea/acre
Phos. Acid	.. o lbs.	20 lbs.	
Yield	.. 739.6	748.6 lbs.	,,
Potash	.. o lbs.	20 lbs.	
Yield	.. 753.3	734.8 lbs.	,,

Differences are not significant.

(C) 24 *plot* (3×8 *Randomised block*) *Experiment*

Nilgiris (*Korakundah*): Yield records from May 1948 to the end of March 1949 are given below:

TABLE 4

Nitrogen	.. 0 lbs.	40 lbs.	80 lbs.
Yield	.. 788.9	861.0	816.7 lbs. made tea/acre

Even after two applications of manure the differences are not significant. It may be mentioned that this area and that of the following experiment are heavily shaded—by Grevillea and Acacia—and that the lack of response to manuring may be attributable to the dense shade.

(D) 24 *plot* (4×6 *Randomised block*) *Experiment*

Nilgiris (*Korakundah*) : Following are the yield figures from May 1948 to the end of March 1949:

TABLE 5

No manure	Nitrogen 50 lbs./acre	Lime 10 cwts.	Nitrogen and Lime
Yield .. 460.6	470.7	482.6	504.7 lbs. made tea/acre

Differences are not significant.

(E) 25 *plot* (5 × 5 *Randomised block*) *Experiment*

High Range (*Kanniamallay*, *Munaar*, *Nullatanni* and *Letchmi*): The yield data for the third year of the experiment from April 1948 to March 1949 are given in Table 6.

TABLE 6

	Control	Nitrogen	Nitrogen and Phos. Acid	Nitrogen and Potash	Nitrogen and Phos. Acid & Potash
Kanniamallay ..	1130.2	1197.7	1220.4	1197.2	1194.5 lbs. made tea/acre
Munaar ..	736.6	802.4	730.1	789.5	734.4 ,,
Letchmi ..	640.4	604.3	627.5	647.3	664.7 ,,
Nullatanni ..	644.7	888.3	918.5	834.8	939.1 ,,

The differences between treatments are significant only in Kanniamallay (P = 0.05, 54.0 lbs. made tea per acre). Analysis of the yield data by covariance method shows that the treatments are significant in Nullatanni also. The lack of response in the case of Letchmi is probably due to late application of manures (October 1948). It is difficult to explain why response to manuring has not been significant in Munaar, especially when significant differences were obtained in earlier years.

(F) COMPOSTS AND GREEN MANURES

24 *plot* (3 = 8 *Randomised block*) *Experiment*

Anamallais (*Iyerpadi*) : The area was pruned during the first week of February 1948 and treatments, 10 tons of cattle manure and 10 tons of green manure per acre, applied during December 1948. The yield figures will be discussed later when the experiment has completed a year.

(G) CULTIVATION

24 *plot* (3 × 8 *Randomised block*) *Experiment*

Nilgiris (*Korakundah*) : Following are the yield data for this experiment.

TABLE 7

	No cultivation	Forking	Trenching
Yield ..	676.9	646.3	777.8 lbs. made tea/acre

Although the difference in yield between no cultivation and trenching is large, it falls short of significance.

(H) PRUNING

(*Tea Experiment Station*)

Slope vs. Ordinary pruning : The third year yield data are tabulated below (for 11 months) :

TABLE 8

Ordinary prune	..	2,203 lbs. green leaf from all plots.
Slope prune	..	2,246 ,, ,, ,,

The third year yield is less than that of the second year and over the whole cycle there is very little difference between the two treatment yields, which are :—

Ordinary prune	..	7,472 lbs. green leaf
Slope prune	..	7,312 ,, ,,

Acknowledgements.—Grateful thanks are due to Managers and staff of the estates visited for help and courtesies received.

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Soil Chemist.

REPORT OF THE BOTANIST
1948-49

The Botanist joined service early in May 1948. To begin with he was mainly concerned with the problem of ' defoliation ' in tea, but since October 1948 he has been in charge of all botanical work. During the first half of the year a greater part of the time was spent in getting familiar with all aspects of tea culture.

Advisory.—Fifty-three enquiries, almost all of them accompanied by specimens, were attended to and reported upon. These were exclusive of enquiries of botanical interest dealt with by the Soil Chemist and the Ag. Tea Scientific Officer. The majority of the enquiries concerned diseases of tea, while some pertained to coffee, rubber and cardamom.

Touring.—Attended the U.P.A.S.I. Scientific Conference at Coonoor during the month of August 1948. Visits were paid (1) to a group of rubber estates in Cochin in September 1948 to investigate a leaf disease of Hevea rubber, (2) to an estate on the Nilgiris in February 1949 to study the cause of deterioration of cardamom and (3) to a group of tea estates in the Nilgiri-Wynaad in March 1949 in connection with ' defoliation " of tea. Besides these, visits were also made to the neighbouring tea estates in connection with vegetative propagation and certain nursery problems.

TEA

Mycological :

Leaf diseases : Brown Blight (*Colletotrichum camelliae*) was frequently reported from a number of estates, though this disease was not serious anywhere.

It may be of interest to mention here that premature drying out of the blisters (Blister Blight) due to invasion of the Brown Blight fungus was reported from some estates. The Brown Blight fungus was isolated from the blisters on all the specimens examined. In the Experiment Station, besides the Brown Blight fungus, the Grey Blight fungus (*Pestalozzia theae*) was also observed in association with blisters. These observations were made chiefly during November/February, the latter part of the Blister Blight period. Some experimental work has been started to determine if there is any antoganism between these fungi resulting in the check of the sporulation of the Blister Blight fungus.

Stem and root diseases : No serious outbreak of any stem or root disease of major importance was reported during the year. However, occasional reports of Pink Disease (*Corticium salmonicolor*), *Rosellinia* sp., and *Fomes* sp., were received.

Particular mention may be made of the large number of root specimens with attack of Diplodia (*Botryodiplodia theobromae*) received from several estates. It is now fairly well established that this fungus is only a secondary parasite invading the bushes weakened by other causes. Almost every specimen examined was found to be either completely deficient or poor in starch, a reserve food material essential for the normal growth of the tea bush. It is possible that frequent droughts experienced in recent years have contributed to a gradual deterioration of the general vigour of the tea plant and have rendered it susceptible to attacks by weak pathogens like Diplodia.

Seedlings.—Some enquiries regarding poor growth of tea seedlings were received from time to time. While in a few the trouble could be traced to a fungus, *Rhizoctonia bataticola*, invading the roots, in others no pathogenic organism could be found associated with poor growth ; the cause in the latter cases was considered to be either insufficient or over-watering and/or probably copper poisoning by spray fluids dripping on to the soil owing to the use of excessive amounts of spray and also high concentrations of the copper fungicides used.

Laboratory studies : (i) Action of certain dyestuffs and chemicals on some tea fungi.

(*a*) Malachite green, an organic dye and one of the series of triphenylmethane dyes, was found to have a selective fungistatic-fungicidal action on some fungi. The germination of the spores of the Grey Blight fungus (*Pestalozzia theae*) was prevented by this dye in as low a concentration as 15 parts per million in the agar substratum, while the growth of another fungus, *Rhizoctonia solani*, on synthetic agar medium was inhibited at a concentration of 4 p.p.m. While this dye seems to be promising in pure cultures, the study of the effect of this material on these and other fungi in their naural habitat is necessary to determine the usefulness of the dye stuff in the control of these pathogenic organisms. It is proposed to test this dye against some of the fungi under field conditions.

(*b*) Up to 100 parts per million in the medium, 2, 4 dichloro-phenoxyacetic acid did not show any inhibiting action on the germination of the spores of *Pestalozzia theae* while the germination of the spores of *Colletotrichum camelliae* was inhibited at the highest concentration tested, viz., 100 p.p.m.

(ii) In a pure culture of a species of *Fomes* isolated from a tea root the mycelium was observed to produce oidia in large numbers some of which were seen to detach from each other and develop into new mycelium. It was also noted that some of the hyphae showed protuberances and a spiked appearance. A similar condition has already been described as a conidium-like resting stage in *Fomes lamoensis* [Palm, B.—*Svensk bot. Tidskr*, 37 : 200-201 (1943)].

Physiological :

1. "*Defoliation*" : In the last annual report, under the head 'defoliation' was described a new decline disease of tea met with mostly on the Nilgiris and Wynaad. During the present year this disorder has been reported from a number of estates in these tea districts. The cause of this disease is still obscure and much time was devoted to the elucidation of this problem. The main characteristics of this "disease" or disorder are (i) the older leaves at the lower parts of the bush fall off, the bush showing a "thin" appearance, and (ii) the growth of the bush is gradually arrested and there is a depletion of food reserves (carbohydrates) in the roots with the consequent death of the affected plants.

Repeated examination did not reveal the presence of any pathogenic organism within the affected plants. Three hypotheses are being investigated, viz., that the cause is a virus, that the disorder is a consequence of droughts or it is due to a deficiency of some nutrient element.

(*a*) *Virus aspect* : There is none of the symptoms usually exhibited by a virosis. Anatomical studies of the plant parts have not so far shown any marked difference between the healthy and the affected plants. Tests for starch lesions in the leaf are negative. X-bodies associated with some of the viruses are absent.

To determine if this disorder is systemic, attempts are being made to transmit this condition to healthy plants by budding and grafting. Gootying is also being tried; a number of treated branches have callused but not yet rooted. It may be of interest to watch the performance of these plants when rooted.

(*b*) *Lack of moisture :* Tea estates on the Nilgiris and Wynaad have experienced severe and prolonged drought periods during the last two years. Meteorological data available at the Experiment Station for the past 20 years show that rain during the period December to March is rather scarce. Especially last year no rain was recorded for 123 continuous days, and in the past five years successive droughts were experienced during the first two and the last two years. Soil moisture determinations at fortnightly intervals (Annual Report of the Soil Chemist for 1943-44) show that it varies from 12·6 to 35.1 % and that during the dry period the moisture level varies from 12.6% to 19.6% which indicates a low moisture level as the calculated wilting coefficient is found to be 11.3. It has been estimated in Ceylon that on a fine day an acre of tea transpires nearly 10 gallons of water which is equivalent to about 3 inches of rain in a month. If this can be taken as the criterion, it can then be considered that the Station and the neighbouring estates experience a drought period of four months from December to March, the average monthly rainfall during these months at the Station varying from 0.39 to 0.84 inch.

Preliminary trials on the effect of mulching and watering the ' defoliating ' bushes have been started. It is too early to comment on these trials, but it may be pointed out that the bushes receiving about 4 gallons of water twice a week during the dry period have put on a healthy appearance when compared with the neighbouring untreated ones. Thus there is an indication that a cumulative effect of drought may be a predisposing factor for this disorder.

(*c*) *Deficiency of nutrients* : Advantage was taken of a $3 \times 3 \times 3$ Factorial Experiment going on at the station for the past 8 years. The treatments consist of N, P and K at three levels, viz., 0, 40 and 80 lb. of N and 0, 20 and 40 lb. of both P_2O_5 and K_2O per acre. These plots have been manured once every year since 1940 and each plot consists of 225 bushes. Counts of bushes showing " defoliation " were made in all the plots giving the following scores : 4 for a healthy bush with a full cover of foliage ; 3, 2 and 1 for bushes showing different degrees of " defoliation " and 0 for a bush that is dead. The total score for each plot was thus computed and the results are as follows :

TABLE 1

Total scores for all plots under treatment

Nitrogen	*Phosphoric acid*	*Potash*
0 lb.—4011	0 lb.—4077	0 lb.—3517
40 lb.—3919	20 lb.—4019	20 lb.—4166
80 lb.—4304	40 lb.—4138	40 lb.—4551

Difference required for significance P = 0.05 = 452
P = 0.01 = 685

The difference between the total scores for the K_0 and K_{20} or K_{40} plots is significant at the 5% level, while that between K_0 and K_{40} plots is highly significant

(at 1% level). However, similar differences are not obtained with the N and P treatments. It may be seen from the report of the Soil Chemist that for the first time after 8 years a significant difference in yield between K_0 and K_{40} has been obtained. It is of some interest to mention here that a similar relationship between potash manuring and increase in yields has been found in Ceylon.

Tests for the amount of potash in the leaves indicated different levels in those of healthy and 'defoliating' plants. Comparable mature leaves were chosen for the tests, the results of which are as follows :

TABLE 2

	Healthy	*Defoliating*
Test 1. $\%K_2O$ on dry weight basis ..	1.37	0.88
Test 2. $\%K_2O$ in ash	15.78	9.18

Further work on this aspect is being continued.

To determine if application of potash to bushes showing the disorder would help them to throw off the malady, pairs of comparable bushes were chosen and to one of each pair muriate of potash was applied at the rate of 60 g. per plant (corresponding to 100 lb. of K_2O per acre). These plants are being closely observed to see if any improvement will result in the growth of these debilitated bushes.

2. *Tea Seed Germination* : A trial with " Grodex ", a proprietory product supplied by Messrs. May and Baker, was made to test the viability of tea seed, as if this product was found satisfactory it would be a quick and easy determination of the germination capacity of a supply of seed within a few hours.

The seeds were split longitudinally, the cut halves immersed in 1% solution of the salt in water and kept for a few hours in the dark. If the seed is viable the reaction between the salt and the living tissues would produce a carmine red stain on the latter.

Two tests with " Grodex " indicated germination percentages of 55 and 68, whereas the actual germination in the nursery was found to be only 39 per cent. The quality of the seed used was, however, rather poor and germination was very slow. A further test with better seed is necessary to be able to determine the value of " Grodex " as a measure of tea seed germinability.

SHADE TREES AND GREEN MANURE PLANTS

Wilting of Dadaps (*Erythrina lithosperma*) was reported from an estate. A species of *Fusarium* was isolated from the roots of the diseased plants.

Fusarium spp. were also responsible for damping off of seedlings of *Gliricidia maculata* and *Grevillea robusta.*

A species of *Pythium* and *Rhizoctonia solani* were isolated from wilted seedlings of Red Gum (*Eucalyptus rostrata*) from a fuel nursery on an estate.

COFFEE, RUBBER AND CARDAMOM

Coffee.—A *Rhizoctonia* sp. was found causing a leaf disease of coffee (*Coffea robusta*) seedlings in a nursery. Dark brown necrotic spots and patches appeared on the leaves and these were permeated by cobweb-like mycelium extending over the green areas on the under surface of the leaves. Spraying the seedlings was recommended with either Bordeaux mixture (5-5-50) or Perenox (2 to 4 oz. in 10 gallons of water), preferably with an adhesive like albolineum (1 gallon for 100

gallons of the spray fluid), at 10-day intervals till the new leaves that were formed were free from the disease.

Rubber (*Hevea brasiliensis*) : A serious outbreak of a leaf disease of Hevea rubber was reported from a group of rubber estates in South India. The disease—leaf spotting—was observed in nursery plants as well as in the mature trees, but it was in the nursery that the damage was severe causing defoliation of the young plants. The affected leaves showed a number of spots on the lamina. In the initial stages the spots or lesions were purple in colour and in the form of pin-points, gradually increasing in size to about 4 mm. in diameter. The young leaf, when affected severely, showed uneven growth of the lamina and a curled appearance. The spots sometimes coalesced. On older leaves the spots were numerous and more often the affected regions became necrotic. The spots appeared purple at first, becoming ashen at the centre with a brown border and on leaves on mature trees they were often ringed by a chlorotic halo. The necrotic areas dropped off presenting a number of holes on the leaf blade. Elongated spots were also noted on the mid-rib and petioles of young leaves on the nursery plants. The causal organism was identified as *Helminthosporium heveae*.

The other fungi identified from the leaf specimens sent for examination were *Gloeosporium alborubrum*, *Fusarium* sp. and *Oidium heveae*. Besides these organisms, Red Rust (*Cephaleuros* sp.), was also noted on a few specimens. However, these were not reported to cause any great damage. Pink disease (*Corticium salmonicolor*) was observed on a few branches in some trees on one estate. The usual control measures were recommended in all these cases.

Cardamom (*Elettaria cardamomum*) : Deterioration of cardamoms was reported from an estate on the Nilgiris. Rhizome-rot due to *Pythium vexans* was observed in some clumps, especially near the streams. This was by no means responsible for the heavy loss of crop reported by the estate.

The degeneration of the clumps was diagnosed to be primarily due to the ' marble ' disease or ' Cardamom Mosaic ' of virus origin with great potentialities for damage. It is believed that this virus is transmitted by an insect, *Pentalonia nigronervosa*, which is also a vector of the banana Bunchy Top virus ; no other mode of transmission of this virus is as yet known. This insect could not be found on the cardamom plants at that time. Suitable control measures for this disease can only fall into one or more of the following groups, viz., (i) control of the transmitting agency, (ii) thorough roguing of diseased plants, and (iii) the cultivation of an immune or resistant variety. Owing to paucity of carefully conducted scientific work on the control of this disease, the only control measure that suggested itself was the rooting out and destruction by burning of all affected plants, as such careful roguing of the diseased plants as and when they occur may be expected to keep the disease within bounds.

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